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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/800,580	03/08/2001	Shuzo Sato	SON-2043	5367

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EXAMINER	
VINH, LAN	

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 03/16/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/800,580	SATO ET AL.	
	Examiner	Art Unit	
	Lan Vinh	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 December 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-7, 9-42, 44-52* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7,9-42 and 45-52* is/are rejected.

7)☒ Claim(s) *44* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☒ Certified copies of the priority documents have been received in Application No. *09/800580* .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Objections

1. Claim 45 is objected because it depends on canceled claim 43.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-5, 9-18, 21-42, 45-52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang (US 6,440,295) in view of Stevens et al (US 6,331,490) and further in view of Basi (US 3,951,710)

Wang discloses a method for forming a semiconductor device. This method comprising the steps of:

forming a trench 125 /interconnection groove in an insulating layer 123 formed on a substrate 124 (col 7, lines 29-34)

forming/stacking a metal layer of copper 121 filling the trench/interconnection groove (col 7, lines 60-66). Fig. 1A of Wang shows that the copper film 121 having uneven surface corresponding to the step difference of the trench/groove on the entire surface of insulation layer 123 to fill trench 125

imposing an electrolyte solution 34 include phosphoric acid/chelating agent between cathode members 1, 2 and wafer 31 having copper formed on the surface,

cathodes 1, 2 are electrically charged to have negative electric potential in comparison to wafer 31 (col 8, lines 66-67, col 10, lines 50-55, fig. 7B), which reads on interposing an electrolyte solution comprising a chelating agent between a cathode member and the copper film, the copper film, formed on the wafer, function as an anode

applying a voltage between the cathode member and the copper film 121 formed on the wafer (col 10, lines 46-50)

selectively removing the projecting portion of copper film 121 corresponding to the uneven surface of the copper film to expose the copper film of the projection portion (col 15, lines 35-42, fig. 1B)

fig. 42 of Wang shows that various power supply output waveforms are repeated for the time periods for the electroplating process, which reads on repeating the film forming step, overpolishing the metal layer 121 to produce flattened copper film surface (col 14, lines 64-65, col 59-61, fig. 1D), which reads on repeating the removing step until the projection portion of the copper film is flattened

Unlike the instant claimed inventions as per claims 1, 23, 25, Wang does not specifically disclose applying a voltage between the cathode and the copper film to oxidize the surface of the copper film by anodic oxidation and form an oxidized copper film/chelating film.

However, Stevens disclose a process for etching a semiconductor wafer comprises the step of specifically exposing the wafer to an electrochemical solution to oxidize the surface of the copper film by anodic oxidation and form an oxidized copper

film/chelating film. Stevens also disclosesthe step of removing the oxidized copper layer (col 11, lines 20-25, col 12, lines 14-17)

Hence, one skilled in the art would have found it obvious to modify Wang's method by oxidizing the surface of the copper film by anodic oxidation and form an oxidized copper film/chelating film as per Stevens because Stevens states that oxidation of copper and the subsequent removal of copper oxide from the copper interconnect structure advantageously provides surfaces that can be selectively electroplating with a protective layer (col 12, lines 22-26)

Wang and Stevens also fail to disclose the step of removing the oxidized copper/chelating film by wiping as required by claims 1, 23, 25

However, Basi, in a method for removing copper contamination, discloses that it is known in the art to wipe copper metal layer with a firm surface (col 1, lines 24-26), which reads on wiping to remove copper metal layer by a wiping member comprising elastic material.

Hence, one skilled in the art would have found it obvious to modify Wang and Stevens by adding the step of removing the oxidized copper/chelating film by wiping as per Basi because Basi teaches that the continuous wiping of the silicon substrate removes the copper from the substrate and produce an extremely flat and well-polished surface on the silicon (col 1, lines 30-34)

Regarding claims 3, 16, 48, 49, Wang discloses forming a barrier layer of TiN to cover the insulation film (col 7, lines 46-49)

Regarding claim 4, Wang discloses applying a voltage to the anode and cathode of the electroplating solution (col 11, lines 14-18)

Regarding claims 10-11, fig. 7B of Wang shows a polishing tool 30 moves on the surface of the wafer.

Regarding claim 12, Wang discloses using drive 30 to oscillate/vibrate the substrate (col 11, lines 52-54). Regarding claims 14-15, Wang discloses monitoring the current density (col 11, lines 4-13). Regarding claims 21, 22, Wang discloses filling the grooves with copper (fig. 7B). Regarding claim 24, Wang discloses forming a stack of layers comprises of different material on the wafer (col 60-63). Regarding claims 26-29, Wang discloses forming dielectric layer 123 of silicon dioxide and layer 123 can include material having dielectric constant less than silicon dioxide (col 7, lines 13-20). The limitations of claims 30-34 have been discussed above. Regarding claim 36, Wang discloses that the copper ions migrate to the cathode (col 10, lines 19-21). Regarding claims 39-42, Fig. 8 of Wang shows pulse-like voltage has rectangular waveform. The limitation of claim 45 has been discussed above. Regarding claim 46, Wang discloses that the temperature of the electroplating reservoir is controlled (col 31, lines 41-42). Regarding claim 50, Fig. 1D of Wang shows that metal film 122 outside of the groove is removed.

4. Claims 6-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang (US 6,440,295) in view of Stevens et al (US 6,331,490), Basi (US 3,951,710) and further in view of Liu (US 5,963,040)

Wang as modified by Stevens and Basi have been described above. Unlike the instant claimed inventions as per claims 6-7, Wang, Stevens and Basi do not disclose using a conductive electroplating plate arranged parallel with the copper film.

However, Liu discloses a method for forming a semiconductor wafer comprises the step of using a conductive electroplating plate 70 arranged parallel with the wafer (fig. 5)

Hence, one skilled in the art would have found it obvious to modify Wang, Stevens and Basi by using a conductive electroplating plate arranged parallel with the wafer in the electroplating solution to obtain an uniform distribution of fines particles of a metal (col 5, lines 7-9)

5. Claims 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wang (US 6,440,295) in view of Stevens et al (US 6,331,490), Basi (US 3,951,710) and further in view of Degani (US 5,904, 859)

Wang as modified by Stevens and Basi have been described above. Wang, Stevens and Basi differ from the instant claimed invention as per claims 19-20 by using phosphoric as chelating agent instead of citric acid.

However, Degani, in a method for forming semiconductor device, teaches that citric acid, phosphoric acid can be used as chelating agent (col 5, lines 26-32)

Thus, one skilled in the art would have found it obvious to substitute Wang, Stevens and Basi phosphoric acid with citric acid in view of Degani teaching because both acids are chelating agents, thus, the substitution of on for the other would have produced an expected result

Allowable Subject Matter

6. Claim 44 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter:

No cited prior art of record discloses or suggest the step of removing a chelate film of oxidized copper from the surface of an oxidated metal film, wherein the chelate film is wiped by a wiping member having an air hole.

Response to Arguments

7. Applicant's arguments filed on 12/22/ 2003 with respect to the references of Wang, Stevens, Basi and Degani have been fully considered but they are not persuasive.

The applicants argue that there is no suggestion to combine the references of Wang, Stevens and Basi because Basi fails to disclose a motivation for combining the references of Wang and Stevens. This argument is unpersuasive because as recited in col 1, lines 30-34 of Basi, Basi teaches that " the continous wiping of the silicon substrate removes the copper from the silicon surface and produces an extremely flat and well polished surface on the silicon"/ the advantage of wiping to remove copper from the silicon substrate. Thus, the examiner asserts that because Basi discloses a motivation/an advantage of wiping to remove copper metal layer from the silicon

substrate one skilled in the art would have found it obvious argue to combine the references of Wang, Stevens and Basi to produce the claimed invention as per claim 1.

The applicants further argue that Basi fails to disclose, teach or suggest an electro-polishing process. The examiner disagrees because as recited in col 1, lines 24-33 of Basi, Basi discloses a CMP process by wetting a silicon substrate with a plating solution containing a cupic cation which is plated onto the silicon substrate as copper metal. Hence, the examiner asserts that Basi suggests electro-polishing process.

The applicants argue that there is no suggestion to combine the references of Wang, Stevens and Degani because Degani fails to suggest a motivation for including citric acid in an electrochemical reaction. This argument is unpersuasive because the examiner only relies on Degani for the teaching that both citric acid and phosphoric acid are chelating agents, thus, the substitution of one for the another would produce a similar expected result. The examiner also notes that the substitution of one known equivalent techniques for another may be obvious even if the prior art does not expressly suggest the substitution. Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989). Thus, the examiner maintains that one skilled in the art would have found it obvious to combine Wang, Stevens and Degani to produce the claimed inventions as per claims 19-20.

Applicants argument with respect to claim 44 has been considered and is persuasive. Therefore, the rejection of claim 44 has been withdrawn.

8. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Conclusion

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 571 272 1471. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LV
March 8, 2004